Pattern Of Distal Tibial Fractures, Associated Injuries And Early Complications At Kenyatta National Hospital.

by Dr. Michael L Lime

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ABSTRACT

Background: Distal tibia fractures arise from different forms of trauma and assume
various morphology or patterns. The patterns of distal tibia fractures could be classified as being open or closed, extra articular or intra articular. Distal tibia fractures have various aetiological mechanisms of injury which can broadly be direct or indirect which results in different patterns of fracture of distal tibia. Associated injuries are usually common especially with high energy fractures. Depending on mode of management and fracture severity, early complications encountered are associated with the poor soft tissue cover and the fact that blood supply to distal tibia is precarious.

The patterns of distal tibia fractures, mechanism of injury, associated injuries and early complications have not been documented in Kenyatta National Hospital.

Objective: To describe the pattern, mechanism of injury, associated injuries and early complications of distal tibia fractures in KNH.

Setting: Accident and Emergency department, orthopedic wards and orthopedic outpatient clinics at KNH.

Study design: Descriptive Cross-sectional

Patients and Methods: The sample size of 82 patients was seen between 1st May to 30th September 2019 with distal tibia fractures. They were recruited through convenient sampling after consenting. Patients demographics, fracture pattern, mechanism of injury, any associated injuries were recorded. Classification of the fractures was based on the AO/OTA using the post injury radiographs. Following treatment, the patients were evaluated again on the third day, 2nd week and 6th week for any complications and wound healing.

All information obtained was recorded in the questionnaire.

Data analysis: Data collected was stratified and analysed based on patient's age,sex,fracture classification based on AO/OTA classification, mechanism of injury ,associated injuries and early complications.Data collected was coded, entered and managed in a Microsoft Access database and at end of data collection exported to SPSS version 24 for final data analysis.Categorical data was presented in tables, graphs and charts.

Results: A total of 82 patients were seen over the study period.Male were 74% and female were 26%.Most common age group was 21-30 years 34% with mean age 35.23 with a range 19-63. Most fractures resulted from motor vehicle road traffic accidents 34%.Closed fractures were the majority 61%.AO/OTA class 43A were the most common type of fracture 55%.The most associated injury was fibular fracture 90%.Early complications were mostly superficial infection 27% that were seen at week 2.

Conclusion: Distal tibia fractures occurred mostly in male patients.Motor vehicle road traffic accidents was the leading cause of these fractures and most common associated injury was fibular fracture.Superficial infection was the common early complication.

1.CHAPTER ONE:INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION

Muller definition of the distal tibial metaphysis is a square constructed with the sides of length defined by the widest portion of the tibial plafond.

The fractures within this square are referred to as distal metaphyseal injuries and define nonarticular fractures as those with no fracture line extending into the plafond (1).

Etienne Destot introduced the term pilon fracture which involves the weight-bearing dome of the tibia being involved resulting from an axially directed force (2).

The incidence of distal tibial fractures (DTF) ranges from 3% to 10% of all tibial fractures or 1% of lower extremity fractures (2).

Study done in Ugheli,Nigeria by Igho et al found an incidence of distal tibia fractures to be 8-16% of all tibial fractures (3).

In Tanzania at Kilimanjaro Christian medical centre Clelland Samuel et al did a retrospective study on epidemiology of tibiofibular fractures of which 9-18% involved the distal tibia (4).

In Kenya,a study on pattern of appendicular skeleton found 12.6% of all tibia fractures were in the distal tibia (5).In this study,she did not correlate the severity of the fracture morphology to any associated injuries or early complications as per the patterns of injury.

DTFs are as a result of two types of forces: Axial compression and rotational forces.
Rotational or torsional forces result into a spiral fracture which may extend into the joint or remain extra-articular.These are low energy injuries and are usually closed, with associated soft-tissue injuries being less severe.
Axial compression forces are high energy leading to fractures that still may or may not extend into the joint as a result of impaction of the convex talar dome onto the concave plafond of the distal tibia.These fractures may be open or closed (2).

A thorough medical history surrounding mechanism of injury should be obtained including patient factors associated with soft tissue complications risk, poor fracture healing, and failure in fixation.Patients must be evaluated fully in terms of physical examination bearing in mind neurovascular assessment of the lower extremity of which could be compromised (6).
The affected lower extremity soft tissue cover should be closely evaluated and checked for any soft tissue compromise.Impending skin compromise that is recognized early and immediate reduction of the fracture decreases the risk of conversion from a closed to an open fracture as well as a compromised surgical approach (7).

Orthogonal (biplanar) anteroposterior and lateral radiographs of the distal tibia are essential to characterize the fracture pattern and enable preoperative templating (8). Computed tomography (CT) is important in planning for surgery.It adds vital information in upto 82% of patients and the surgeon might decide to change the surgical plan in 64% of patients. It is highly advocated for if there is suspicion for intraarticular fracture extension (6).

Classification of distal tibia fractures uses the AO/OTA classification system which is now accepted for distal tibia fractures. In this system, DTFs are classified into the various categories:

type A, nonarticular/extra articular fractures; type B, partial articular fractures; and type C, total or completely articular fractures (1).

Ruedi and Allgower classification is commonly used for intraarticular fractures which is based on the comminution severity as well as articular displacement. Prognosis correlates with increasing grade (9).

Swiontkokoswki et al study found that using the AO/OTA system,the observer agreement was moderate especially in fracture type(A,B,C) determination.On the other hand fracture grouping eg C1,C2,C3 had a poorer observer agreement (10). Martin et al while comparing fracture classification between AO/OTA with Ruedi and Allgower found improved interobserver reliability categorizing fractures into major types with AO/OTA system than with Ruedi and Allgower (11).

The Ruedi and Allgower classification classifies distal tibia fractures extending into the ankle joint while the AO/OTA classification is more comprehensive and includes both the non articular and the ones that have articular extension.

This study will use the AO/OTA classification.

The literature lacks recent studies describing the pattern, mechanisms of injury,associated injuries and early complications of distal tibia fractures in the local setting. The main objective of this present study was to describe the pattern,mechanism of injury,associated injuries and early complications of distal tibia fractures in a Kenyan setting to improve patient care.

1.2 LITERATURE REVIEW

Epidemiology and mechanism of injury

In their study Sitnik et al found the incidence of DTFs to be 3% to 10% of all tibial fractures or 1% of lower extremity fractures.In more complex injuries,there is usually associated fibular fracture in upto 70% to 85% of cases (2).

An epidemiological study showed the fracture burden caused by DTFs to be 7.9 per 10,000 annually with an incidence of 0.7% of all fractures (12).

Distal tibial fractures with intra articular involvement represent 5-7% of all tibial fractures (13).

Distal tibial fractures are as a result of two types of forces: rotational force and axial compression loads.Torsional forces /rotational forces lead to a fracture that's spiral which could be extending into the joint or remain extra articular. These fractures are low energy and mostly closed, and have a less severe soft tissue injury.However, for the higher energy axial compression forces that occur during motor vehicle accidents, falls from heights, motorcycle accidents, and industrial mishaps lead to fractures of the distal tibia with articular extension with the convex talar dome driving into distal tibia plafond which is concave (7). Severity of the articular injury depends on the amount of applied energy and the foot position at the time of impact.

Rapid axial loading absorbs energy and releases more energy at failure with the resultant fracture and this released energy is transferred to the soft tissue. The articular surface may be involved in part or the whole articular surface may be involved. Confinement of the injury could be to an epiphyseal area just proximal to the joint, it may involve both the epiphysis and metaphysis or it may as well have an extension into the diaphysis (7).

Surgical anatomy of distal tibia

Muller defined the metaphysis of the distal tibia by drawing a square with the sides of the length being the widest portion of the tibial plafond (1).Fractures within this square of the tibial plafond to be considered distal metaphyseal injuries and nonarticular fractures as those with no fracture line extending into the plafond.

Distally the tibia articulates with the dome of the talus to form a saddle-shaped congruent weight-bearing surface.Normally under physiological conditions, the peak loads sustained by the ankle joint are almost four times the weight of the body. Load of upto 80 to 90% is transmitted via the plafond of the tibia to the dome of the talus and only 17% through the fibula . To break the articular surface of the distal tibia and the metaphysis,then high energy trauma is needed (14). At the junction where the tibial diaphysis meets the distal metaphysis, there is a transition from a triangularly shaped tibia to a rounded shape.

The surrounding cortex thins and is replaced centrally with cancellous bone and metaphyseal secondary spongiosa. In patients who are active, there is dense cancellous bone, which provides secure purchase for screws.

With aging, distal tibial metaphysis changes which results in distal canal diameter being increased and decrease in density of cancellous metaphyseal bone (6).

Biomechanics of bone failure

Bone is usually strongest in compression and weaker when subjected to tension forces.During tension,a force creates a stress in a specific part of bone that is loaded which ends up with failure of the region first.

When a bone is bent,the convex side of the bone will elongate and be subjected to large tensile stresses.This results in failure as a cortical crack is formed resulting in a transverse fracture.

Layers below outer layer fail as they are still subjected to high tensile stress.No crack is initiated on the concave side as this part is subjected to compression forces.

Bone subjected to torsion/axial loading results in spiral fracture.As the torsion loading is applied,a fracture develops at a point on the bone and is propagated at an angle of approximately 45 degrees to the long axis of bone around the shaft in same direction as the torque applied.As a result the shaft becomes unstable when the fracture completely encircles the bone.

This results in a longitudinal fracture line forming between the proximal and distal ends of the spiral fracture (15).Part of bone with least diameter is the least stiff hence reason for torsional fractures in the narrow distal tibia.

Cortical bone subjected to purely compression fails by shearing or sliding along oblique surfaces but in trabecular bone,results in crushing/comminution of the metaphyseal bone of the distal tibia which is usually weaker

Sociodemographic profile

Worldwide musculoskeletal trauma considered a public health burden that results in high morbidity,mortality and disability.This results in increased healthcare expenses and reduced productivity as a result of suboptimal function.

There is a male predominance in distal tibia fractures.Holagundi et al study of functional outcome with surgical management in distal tibia fractures found 80.6% were male and 19.3% were female (16).

Irfan Ali et al study of evaluation of functional outcome in DTFs found 87.5% were males and 12.5% were females (17).Male predominance could be attributed to male involvement in manual activities i.e construction,vehicle driving,motorcycle riding,working in fields and factories.

In terms of age distribution,DTFs has a distribution that is bimodal with fractures of high energy occurring in younger age group while fractures of low energy occurring in older age groups.Holagundi et al found patients in the age group 18-29years comprising of 43.3% to be the majority (16).

Clelland et al in a study in Tanzania found patients in the age group of 21-30 with 25% of total cohort were the most common.Males in the age group of 21-30 were the most affected accounting for 31% of fractures that occurred in males.Females in the age group of 51-60 and 61-70 were the most common accounting for 19% of fractures in female patients (4).

Mechanism of Injury

Distal tibia fractures have various aetiological mechanisms of injury. This can be broadly grouped into direct or indirect. Causes of direct mechanisms of injury include fractures of high-energy i.e RTAs, penetrating injuries, and 3-point bending injuries.These mechanisms of high-energy result in fractures that are transverse or comminuted and displaced with higher rates of open fractures and severe injury to the soft tissue.

Indirect mechanisms are largely torsional, low-energy injuries. They tend to result in fractures that are spiral, nondisplaced or minimally displaced,less comminuted and these are associated with minimal soft tissue injuries.

Main causes of DTF can be grouped into five categories: Road traffic accidents, falls from different height levels,sports related injuries, direct blows or assaults and injuries as result of gunshot (2,6)

Road Traffic Accidents

Road traffic accidents (RTAs) are a major contributor in terms of global morbidity and mortality, with almost 1.3 million people dying as a result and 20 to 50 million others getting injuries that lead to incapacitation each year (18).

Court-Brown et al in the Edinburgh series found incidence of DTFs to be 37.5% due to RTA (19) .Of the total fractures due to RTAs, 59.3% were closed fractures. Pedestrians recorded the highest incidence of distal tibial fractures among RTAs accounting for 59.2% while motorcyclist the least at 22.4%.However, motorcyclist largely sustained open fractures at 63.6% with most of them being young (average age of 28.4 years).

Baral et al in Nepal India in their study,found that motorcycle accidents was the major cause of distal tibia fractures at 48.5%,followed by automobile pedestrian at 39.4% (20).Ravishankar et al found that road traffic accidents were the main cause of distal tibia fractures at 83.3% followed by sports injuries.They attributed this to poor road traffic sense and poor road network in India (21).

Kigera & Naddumba, 2010 study in Uganda on motorcycle crashes, found that motorcycles contributed 73% of the trauma patients with majority of the fractures being in the lower limb and the leg being more involved (22).

In Peris study of appendicular skeleton fractures carried out in KNH,she found that 52% of distal tibia fractures were due to RTAs followed by falls at 48% (5).

Falls

Falls may be categorized into simple falls, falls down the slope or stairs and fall from heights. Simple falls result when a patient falls from a standing height.They are commonly seen in the elderly and flailing persons.In his series Court-Brown et al found incidence of 17.8% with most being closed at 91.2% with relatively simple fracture configuration,Tscherne G1 at 59.8%.

Fall from heights were the least at 6.2% but with most of them (53.1%) being open fractures 47.1% of which were Gustillo III (19).

Baral et al found falls to comprise 6.1% of distal tibia fractures (20).

Sports injuries

Sports-related tibial fractures incidence and severity vary from country to country depending on the popularity of a particular sport.

The study in India reported an incidence of 5.5% in sports/football related injuries in distal tibia fractures.Fractures resulting from sports are mostly of low velocity and usually give rise to OTA type A hence majority (95.6%) are usually closed (20).

Court-Brown et al found 30.9% of all fractures of the distal tibia being caused by sports with an average age of 23.5 years (19). A majority of the fractures resulted from soccer at 80.1% and a small fraction were due to skiing at 7.5%.

Direct Blows/Assaults

These account for upto 4.5% of all DTFs. They are more common in patients who are younger and have less-severe fracture morphology, 69.6% being classified in OTA type A

Levy et al in a study involving baseball assault patients,found OTA type B/C in upto 69% of the fractures and had significant soft tissue damage similar to injuries sustained in RTAs, gunshot wounds, and crushing injuries (23). Notable in these injuries is that there was an increased risk of compartment syndrome at nine times that of their total tibial fracture population. Repeated soft tissue damage causing damage to muscle that is significant but not of much severity to fascial tear may explain this finding.

Labronici et al in Brazil 2005 found that 6.4% of distal tibia fractures were due to direct trauma (24).

Gunshot injuries

Gunshot injuries are considered trauma secondary to high energy and vary as dictated by the type of gun that is used to inflict the injury. The muzzle velocity of the weapon used determines the fracture morphology and the nature of soft tissue damage.

Data related to the incidence of DTF secondary to gunshot in the general population is scanty. In the United States where there is quite a high number of injuries secondary to gunshot in the major cities, most of the patients who sustain DTF are usually young, homeless or about to be imprisoned for crimes. This complicates follow up of such patients thus paucity of information on these fractures

Lieder et al in a study of distal tibia fractures caused by gunshots,found 49% involving the distal tibia with average age of 27years.Of these 28% propagated into the tibiotalar joint (25).

Fracture Patterns/morphology

DTF can simply be classified as either open or closed,or if its extra articular or intra articular.

Open fracture classification uses the system that Gustilo and Anderson proposed in 1976 and which underwent modification in 1984 (26). The classification depends on increasing soft tissue injury.

In Labronici study of treatment of distal tibia fractures,he found that 31.9% of distal tibia fractures were open and 68.1% were closed (24).

Mihail-Lazar et al study of extra articular distal tibia fractures found 26.4% of fractures to be open and 73.6% to be closed (27).

Baral et al found an incidence of closed fractures at 65% and open type at 35%.

Stevens et al study of distal tibia fractures in 3 developing countries of 160 patients had an incidence of 40% open fractures and 60% closed fractures (28).

Majority of distal tibia fractures are closed type which could be due to low energy trauma.

Tscherne classification has been proposed for closed tibia fractures. This is usually pegged on the amount of abrasions and contusions on the soft tissue, the fracture morphology on the imaging or radiologic appearance, the presence or absence of closed degloving, the presence of injuries to major blood vessels including rupture, and the presence of signs of compartment syndrome.

In terms of intra-or extra-articular fractures, Gao et al found 43.7% to be intra-articular while 56.3% to be extra-articular (29).According to AO/OTA classification,there were 53.1% of 43A type,3% 43B and 43.7% of 43C type.

In their retrospective study Joveniaux et al of 101 distal tibia fractures,21.7% were type 43A,50.4% were type 43B and 27.7% were type 43C.The minimal number of extra articular fractures could be due to the less number of low energy fractures at 26.7% in this study (30).

Choudhari et al study found most fractures to be extra articular with 60% being extra-articular and 40 % being intra-articular.According to AO/OTA,60% were 43A,20% were 43B, and 20% were 43C.High energy trauma was 55.7% in their study (31).

In terms of fracture pattern,Ravishankar et al found incidence of transverse fractures at 43.3%,oblique fractures at 20% and spiral fractures at 20% (21).

Fracture patterns dictate the level of energy with high energy resulting in a comminuted fracture and could be open.Low energy with a twisting mechanism gives a simple fracture pattern with less soft tissue injury.

Fracture patterns help in treatment decisions either non operative or operative.

Fracture morphology will be associated with different complications eg soft tissue damage,neurovascular and later on could influence development of osteoarthritis (7,14)

Associated injuries

It is imperative for the examining clinician to note that there may be other injuries associated with DTF especially in high energy injury. Fracture of the fibula is the most common associated injury.

Court-Brown et al found the fibula was fractured in 77.7% of distal tibia fractures (19).

Bonnevialle et al study of distal leg fractures found an incidence of 7% of intact fibula and 93% of associated fibula fracture of which 37.3% was a fracture at same level as tibia,29.6% was a fracture proximal to the tibia fracture and 17.6% was a fracture distal to the tibia fracture (32).

Robinson et al found an incidence of 8% intact fibula and 92% of associated fractured fibula in their study.Majority of the fractures had 86.5% classified as high energy (33).

In associated fibula fractures, it is vital to document in that its fixation helps in maintaining length of the leg and avoids limb length discrepancy.

Gao et al in their study found associated trauma in 28% of the patients.Patients with polytrauma were 3%,who presented with head injury,contusion to the lungs and fracture of the acetabular on the ipsilateral side.Patients with contralateral tibia fractures were 12.5%.Patients with ipsilateral farctures of talus,calcaneus and patellar were 9.3% (29).These fractures were correlated to level of energy and were statistically significant in trauma related to high energy trauma.

Data on proportion of other regions injured in association with distal tibia injuries is not available or quite scanty locally. Thus this study will highlight these associated injuries including but not limited to head injuries, chest trauma, other long bones injuries and pelvic injuries.

CLASSIFICATION

To describe distal tibia fractures,a number of classification systems were developed. The Association for Osteosynthesis (AO/OTA) criteria was developed especially to be applied in research and all fractures are described by being assigned alphanumeric code (34).

This AO/OTA form of classification system is currently used to classify distal tibia fractures. In this system, DTFs are categorized into:

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- Type A- nonarticular or extra articular fractures;
- Type B partial or minimally involving articular surface;
- Type C total or complete articular fractures.

The fracture classification is organized according to morphological complexity, severity,treatment difficulty, and the prognosis.

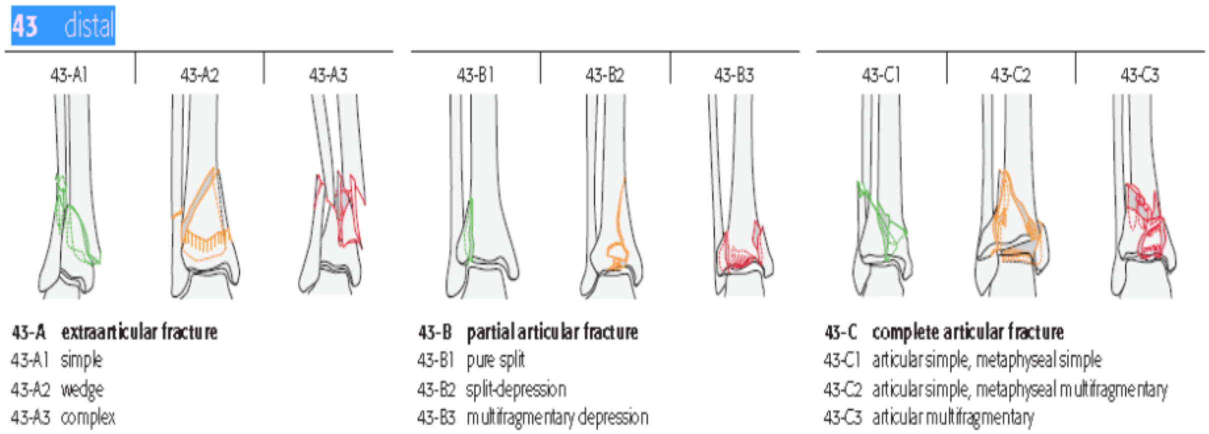

Figure 1:Classification of DTFs according to AO/OTA

Apart from the AO Classification the other type of classification is the one by Ruedi and Allgöwer . It divides DTFs into 3 groups and laid the basis on which the AO Classification was formed, and which currently its use is widespread (35).

Classification by Ruedi and Allgower depends on the communition severity and the articular fracture fragment displacement. Prognosis correlates with increasing grade (9).In this classification ,both inter-observer and intra-observer agreement has been shown to be poorer than the AO Classification (11).

Tscherne and Oestern came up with a classification to describe the associated soft tissue injury in closed fractures which were not covered by both AO or Ruedi and Allgower classification (36). The energy transferred to the soft tissues has a direct correlation with the energy on the bone and the fracture pattern for closed fractures which forms the classification basis for the Tscherne and Oestern classification.Hence the higher energy fracture patterns results in more severe soft tissue injury.

In 1976,a grading system was developed offering information on the prognosis of fractures that were infected by Gustilo and Anderson (26). There was modification of the system in 1984. This was done depending on the wound size,amount of damage to the soft tissues,stripping of the periosteum,and presence of any injury to the vessel.

Categorizing of fractures to bone as well as injuries to the soft tissue assists in passing on of information or communication and for data storage. It may also assist in defining fracture management and predict simple outcome measures (37).

AO system of classification is predictive of weight bearing time and time to return to activities of daily living.

Gustillo classification is predictive of time to union and incidences of non-union, malunion and infections but does not predict the outcome functionally. On the other hand the Tscherne classification is predictive of union time as well as time to return to activities of daily living

DIAGNOSIS

The patient history allows determination of the involved energy in terms of its amount, which then allows assessment of injuries to the skeletal or other systems involved.The surgeon also evaluates the likelihood of development of severe injuries to the soft tissues as evidenced by swelling and blister formation of the soft tissues on distal tibia.Any medical comorbidities as well as smoking are especially vital and this history may change the surgical approach or intervention to these patients.Other risk factors e.g alcoholism,malnutrition,peripheral vasculopathy,diabetes mellitus and it's associated neuropathy may increase infection risk and non union as well as affect choice of fixation (38).

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Recognizing these risk factors may help prevent complications and improve functional outcome postoperatively (8).

Distal tibia fractures frequently result from a setting of high-energy multiple trauma. Consequently, initial evaluation and treatment should proceed per Advanced Trauma Life Support protocols.

Patient should undergo a complete physical examination . It is important to evaluate the lower extremity for distal compromise of the neurovascular status.Immediate fracture reduction should be attempted if vascular compromise is found.

Compartment syndrome should be looked out for in this assessment and especially in fractures that are closed.If suspected then compartment release through fasciotomy should be done urgently.

Closely examine the soft tissue cover of the involved distal tibia.For any fracture that is tenting on skin which can easily convert a closed fracture to a fracture that is open needs to be reduced urgently to reduce chances of compromising surgical approach.

Signs that show there is injury to the soft tissues include;oedema,blisters as result of fracture, ecchymosis and wounds in open fracture types.The distal metaphyseal fractures sustain greater injury than diaphyseal fractures (33). As a complication of the thin subcutaneous tissue envelope,the medial surface of the tibia usually results in open injuries whose incidence approximates 20%.

After a thorough assessment, the limb splintage should be performed, awaiting definitive management

IMAGING

It is important to classify the injury sustained hence the need for radiographic imaging which also assists in determining the surgical intervention and approach. Fracture imaging includes orthogonal views of the distal tibia and ankle mortise which are vital in characterizing the fracture pattern. To ensure additional injuries are not missed,then knee anteroposterior and lateral views as well as leg radiographs capturing both knee and ankle are obtained (6).

CT scan is recommended for pilon fractures involving the joint and and this is vital for the surgeon to be able to delineate the geometry of the fracture and that of the articular surface to preoperatively plan for the surgery (39).CT scan adds information in 82% of patients and there might be a change in the surgical plan in up to 64% of patients (40).Mostly rrequested for the fractures extending into the joint and might not be properly delineated on radiographs.

For minimally invasive percutaneous techniques,it is paramount to evaluate the articular fixation orientation and location.This is mostly possible if the size,location as well as articular surface displacement is determined with the use of CT scan.The information that is obtained from CT scans facilitates an accurate surgical plan and this allows the surgeon to apply fixation with minimal soft tissue handling hence reduction in soft tissue which preserves the little blood supply.

The fracture fragments encountered in fracture of the tibial plafond include; (41).

1. Fracture fragment of the medial malleolus or fracture due to rotation.
2. Fracture fragment of the anterolateral distal tibia as result of axial force.
3. Fracture fragment of posterolateral distal tibia due to axial compression
4. Fragment of the anterior part of tibial crest as result of hyperextension
5. Fragment of the posterior part of tibial crest as a result of hyperflexion
6. Fracture fragment of the central part as a result of axial force.

For proper determination of fracture relationships CT scan is advocated for after a temporary reduction of the fracture is obtained with a spanning external fixator from which one can be able to plan for the surgery.

TREATMENT

DTFs treatment remains a great challenge to the orthopaedic surgeons.Several methods of management encompass closed reduction and cast application,or external fixation for open or severe soft tissue injury,open reduction and internal fixation,intramedullary nailing and minimally invasive plating.

Each of the methods have their own merits and demerits.

Conservative treatment plays a role in fractures that are undisplaced and fractures that don't displace while in a cast on subsequent follow up.Patients at risk of anaesthesia or patients who have high surgical complications risk due to soft tissue conditions or patients who refuse any surgical intervention are other indications for conservative treatment.

Following reduction using closed method,the lower leg is carefully padded with plaster cast and partial weight bearing commenced at 6 to 8 weeks in stable fracture that is non displaced. Jagero study found non complicated fractures likely to unite by 18 weeks and complicated ones after 18 weeks managed in a cast.

Fractures involving distal tibia with intra-articular extension require surgical intervention.Aims are the joint surfaces need anatomic reduction with proper alignment in the axial and coronal planes and the internal fixation should be stable/rigid allowing for early functional recovery.

In 1969 four steps were recommended in management of these fractures especially for closed fractures by Ruedi and Allgower. The steps included fibula reduction and stabilization to maintain length of the leg,tibia articular surface reconstruction to achieve anatomical reduction, the depressed articular and metaphyseal defects are bone grafted with autografts and finally reconnect the metaphyseal block to the diaphysis (42).All these was done as a one stage procedure and these had its own disadvantages especially wound complications.

Towards the end of 1990s,there was a proposal for a staged procedure of DTFs due to soft tissue complications encountered with the single procedure (43). Application of an external fixator medially until soft tissue injury subsided was the first stage.Second stage involved the definitive management in which fixation was done only after soft tissue oedema resolution.This took at an average of 7 to 14 days after the injury.The temporary external fixator is useful to achieve alignment and stabilisation of the fractured bone as well as soft tissue stabilisation until the soft tissue injury has resolved and therefore conducive for intervention surgically.Signs to look out for are skin wrinkle sign appearance and resolved blisters.Anatomic reduction of articular fracture is achieved by opening the fracture, reducing the fracture and internal fixation (13).

The external fixator works on the principle of ligamentotaxis with most fixators assembled to give a spanning construct over the ankle joint i.e tibiotalar calcaneal fixation.However,circular fixators allows assembling of a tibial only construct and this has an advantage of mobilizing the ankle joint early preventing ankle stiffness.It also allows partial control of the fracture fragments comminution depending on the size as well as wire orientation with a juxta-epiphyseal assembly.

Spanning external fixator is recommended for temporizing management of open intra or extra articular fractures with extensive comminution and soft tissue injury (44).It restores and maintains length,alignment and preservation of soft tissue cover pending definitive treatment.Hybrid external fixator can be useful in the setting of fractures that are open with comminution and with soft tissue injury that prevents plate fixation. Unlike spanning fixator,hybrid fixator has an advantage of bearing weight early and allows early ankle motion exercises (44).

Patients who present with open fractures or severe soft tissue injury,then its paramount to carry out radical surgical debridement of all the contaminants,devitalized tissues and fractures be stabilized with external fixators,spanning or non spanning the ankle joint.Proper antibiotics should be instituted for prophylaxis cover.

For exposed bone surfaces then planning for wound cover with appropriate flap transfer be planned as this improves overall outcome (35).

In addition vacuum assisted wound closure plays a major role in contracting the wound,reducing edema and enhances circulation at the wound site and this reduces chances of wound infection.

For compartment syndrome that has been diagnosed,then early fasciotomy to decompress the leg compartments reduces the risk of detrimental outcome in these fractures (45).

EARLY COMPLICATIONS

DTFs are known for their poor and limited soft tissue envelope,limited and poor blood supply and fractures in this region tend to be complex.This poses a challenge in terms of management and their propensity to complications.

Kline et al had in their study a complication rate of 41% in DTFs (46).More than half of the complications that they classified as major occurred within 3 weeks.Other studies found complications to be 35%-37% undergoing open treatment.The rate of complications was lower for the fractures managed in a staged manner unlike the ones managed as one stage.

The ones operated on using minimally invasive percutaneous osteosynthesis preserving the local soft tissue cover and blood supply also had reduced complication rate (43,47)

Viberg et al in Denmark found complication rate of 69% in their study using low profile medial locking plate (48).Their high proportion of complication was attributed to their multicenter nature of their study in which treatment choice and the technique of surgical operation relied on the local surgeon.In this study high number of patients were treated according to single stage protocol.

Early complications mostly encountered in distal tibia fractures include compartment syndrome,superficial infection,deep infection and complications related to surgical wound healing.

Compartment Syndrome

Defined as elevated pressures within the osseofascial compartment that is limited leading to a decrease in perfusion with detrimental results of irreversible muscle and nerve damage and consequently loss of function.

It is crucial to watch out for compartment syndrome either imminent or already developed and perform an emergent surgical fasciotomy to release all compartments and decrease chances of irreversible damage (49).

Kostler et al found 1-29% incidence of compartment syndrome after fractures of tibia that are closed while between 1-10% for fractures that are open (45).

The rate of compartment syndrome appears to be high for fractures involving the diaphysis than fractures involving the proximal or distal tibia.It also is higher for patients who are young and involved in sports (45).

Superficial infection

These are wounds treated with local wound care in form of cleaning and dressing and antibiotics orally and don’t require debridement.Includes infection secondary to pin tract in those fixed with external fixators and infections due to superficial surgical wound.Kline et al found 13.2% superficial infection in both diabetic and non diabetic with higher proportion of 29% in diabetics alone.With a staged operation then the infection rates were lower (46).

Ali et al found 16% of their patients to have superficial infection in which they used percutaneous minimally invasive techniqie.All their patients were managed with dressings and antibiotics and the infections subsided (7).

Deep infections

These include wounds that require debridement surgically or otherwise and a course of intravenous antibiotics.Kline et al found 14.5% deep infections in their study with most of them occurring in the setting of open fractures and less occurring in staged treatment of closed fractures (46).

Joveniaux et al found a correlation of deep infections with high fracture severity especially for the ones who required external fixation for their open fractures (30).

Surgical wound healing complications

This include wound breakdown or dehiscence that required debridement surgically,and a secondary wound cover eg skin grafting or flap coverage due to an exposed bone.A secondary intervention has to be performed for them to be called wound healing complications.

Kline et al found 7% of wound breakdown following a fracture that was closed treated with a two staged protocol which required a flap (46).

Determining the presence of wound infection is a challenge especially for surgeons.Several definitions of wound infections been described i.e

i) United States Centers for Disease Control and Prevention.

ii) The English Nosocomial Infection National Surveillance Scheme (NINSS).

iii) Asepsis Wound Scoring System (AWSS).

The CDC definitions for surgical site infection surveillance will be adopted for this study to determine if there is any infection or not on the third day,the second week and 6th week after surgical intervention or conservative treatment. The parameters to check include; 1) Purulent discharge. 2) At least any of these infection signs and symptoms;redness,swelling that is localized,and pain or tenderness. 3) infection diagnosis made by the operating surgeon (50).

CONCLUSION

Most of the studies are retrospective with all the disadvantages of retrospective studies.

Settings where most of the literature came from is quite different from the local set up i.e a tertiary teaching hospital and the socioeconomic status.

Lack of uniform classification and diagnostic systems resulting in conflicting literature with an effect on fracture severity hence management.

Local studies have not evaluated and described distal tibia fractures hence this study could form a basis of other studies.

There has been no local study to correlate early complications to fracture severity or fracture treatment,which this study would try and fill that gap.

1.3 STUDY QUESTION

What are the patterns,mechanism of injury,associated injuries and early complications of distal tibia fractures at KNH?

1.4 STUDY JUSTIFICATION

Tibial fibula fractures are among the commonest fractures seen at Kenyatta National Hospital

Distal tibia fractures have always posed a challenge to treatment particularly with associated injury to the soft tissue and comminution.

Fractures of the distal tibia are often as a result of road traffic accidents and can compromise ankle joint integrity especially the ones that are intra-articular,with subsequent loss or limited in function of the ankle. With the evolution of more transport by motorbike, there has been substantial rise in road traffic crashes in Kenya related to motorcycles.

In recent years, the number of motorcyclists has increased, the road network has improved and the construction industry has also grown exponentially.The training of the motorcyclists is however inadequate and this could have an impact on the type of injuries sustained.

In the local setup,there is paucity of data available on pattern,mechanism of injury,associated injuries and early complications of distal tibia fractures.

Well elucidated etiological mechanisms of injury will help highlight probable areas of primary intervention and need for strengthening the pre-existing preventive measures for DTFs in the local set up such as review of the national road safety or at construction sites.

1.5 STUDY OBJECTIVES

1.5.1 Broad Objective

To study the pattern, mechanism of injury,associated injuries and early complications of distal tibia fractures as seen at Kenyatta National Hospital.

1.5.2.Specific Objectives

1. To describe the pattern and mechanism of injury of distal tibia fractures seen at Kenyatta National Hospital
2. To determine presence and nature of associated injuries of distal tibia fractures.
3. To determine the early complications in patients with distal tibia fractures.

CHAPTER 2:METHODOLOGY

2.1 STUDY DESIGN

Descriptive cross sectional study

2.2 STUDY SETTING

KNH A&E department, orthopedic wards and outpatient orthopedic clinics. KNH is a tertiary Level 6 national teaching and referral hospital with a 300 bed orthopaedic unit serving Nairobi county,its neighbouring counties,and the whole country at large via the national referral system.

2.3 STUDY POPULATION

All patients aged 18 years and above presenting to Accident and Emergency Unit,patients admitted in the orthopaedic wards and those presenting in the orthopaedic clinics with distal tibia fractures..

2.4 SAMPLE SIZE

Using the Fischer's formula,sample size calculation is as follows;

$$n_0 = \frac{Z^2(1-\infty/2) \times P(1-P)}{d^2}$$

Where;

n_0 = sample to be determined

Z^2 $(1-\infty/2)$ =is the standard error of the mean corresponding to a 95% confidence interval whose corresponding value from a t-table is 1.96.

P =is the expected prevalence of the event to occur. Value of P was 0.1.

d = is the target margin of error which will be 5 % (0.05) to increase precision.

$$n_0 = \frac{1.96^2 \times 0.1\,(1 - 0.1)}{0.05^2}$$

Therefore, $n_0 = 139$.

Kenyatta National Hospital has three orthopedic wards and clinics that together admit approximately 15 and 20 distal tibia fractures patients per month, respectively. Assuming four of the 35 patients satisfy the exclusion criteria, we have 31 patients per month. The study envisages a recruitment period of 3 months which will result into a study population of 93 patients.

However, given the small population, we modify Fischer's formula by including the finite population correction factor (fpc) as follows ;

$$n = \frac{n_0 N}{n_o + (N-1)}$$

Where;

n= Sample size to be determined from the finite population

N= Total population and n_0 retains its earlier definition

Therefore;

$$n = \frac{(139)(93)}{139 + (93-1)} = 56$$

Assuming an attrition rate of 10%, the expected sample size will be 62. The author proposes to utilize purposive/convenient sampling based on the defined inclusion criteria until the appropriate sample of 62 is reached or a statistically sound level possible under the circumstances is attained.

From the KNH registry,a total of 93 patients are on average seen over a period of 3 months hence the sample size of 62 patients above can be realized.This number was the minimum number of participants for my study.

2.5 INCLUSION CRITERIA

Patients who were 18 years and above of age.

Patients who gave consent/or by guardian for those who had head injury.

Patients with distal tibial fibula fractures involving distal square of the tibia plafond.

Patients with distal tibial fractures within 72 hours from the time of injury.

2.6 EXCLUSION CRITERIA

Patients with pathological fractures.

Patients with fractures of more than 72 hours from time of injury.

Patients with fractures with other comorbidities i.e diabetes mellitus

2.7 METHODS

Patients were recruited into the study by the principal investigator and two research assistants using method of convenient sampling. The two research assistants were orthopaedic technologists with experience in orthopaedic practice. They were trained on collecting data from five patients with distal tibia fractures..

The principal researcher and/or his research assistants reviewed the patients file and radiographs for eligibility into the study. Those that met inclusion criteria were recruited into the study.

The demographic characteristics of the patients i.e age,gender were entered in the data collection sheets.Aetiological mechanism of injury details,associated injuries were sort.The mechanism of injury details included either high energy trauma which entailed road traffic accidents,falls from height greater than four metres or low energy trauma resulting from torsional forces which included fall from standing height or direct blows to the distal leg.

Patients were assessed clinically for the fractures of the distal tibia and the injuries to soft tissue including open fractures using Tscherne and Ostern and Gustillo and Anderson classificatons respectively. Associated injuries were also assessed and recorded in the data questionnaire

The post injury true anteroposterior and lateral radiographs, with standardized magnification and calibration, was assessed by the principal researcher for the injury pattern and classification done as per the AO/OTA classification system (Appendix 3).The Xray machine used was the digital Xray,model definium 600 at the radiology department of K.N.H.The radiographs were done by diploma trained radiographers under the supervision of consultant radiologists in K.N.H.Interpretation of the radiographs was done by an orthopaedic resident but in case of uncertainty,a radiologist and a qualified orthopaedic surgeon were consulted.

Patients' management was thereafter as per the hospital's protocol.Patients were then followed up at day 3,day14 and at 6 weeks to assess for wound healing and any infection complications. The early complications that were looked for were the ones that occured from the time of injury upto 6 weeks post injury.These included compartment syndrome,superficial wound infection,deep wound infection and wound dehiscence. The parameters in CDC definitions of surgical site infection was used to assess the presence or absence of infection.

All the data collected was recorded in the data collection sheet for analysis of data.

2.8 DATA COLLECTION AND MANAGEMENT

Collection of data involved use of a standard data sheet. Data collected included:

- Patient demographics
- Mechanism of injury
- Fracture classification
- Associated injuries
- Early complications

Data collected was coded, entered and then managed in a Microsoft Access database and at the end of data collection exported to SPSS version 24 for final data analysis. Means, medians and proportions were determined for the quantitave variables.

The hospital based incidence of the distal tibia fractures would be determined. The distal tibia fracture pattern was correlated to the injury mechanisms, the patient demographics and presence of associated injuries using Chi square test.The early complications were correlated to the fracture classification.

A P value of <0.05 was considered statistically significant at 95% confidence interval. The presentation of the results of the study was in forms of tables, graphs and pie charts.

2.9 ETHICAL CONSIDERATIONS

Before commencement of the study,approval was sought from the department of orthopaedic surgery,University of Nairobi and the KNH ethics and research committee(KNH/ERC).

Informed consent was obtained from the patients or guardians who accepted to participate in the study.This was after patients were given a clear explanation about the study.

For those who didn't consent, they received treatment as per the regular hospital protocol.

2.10 STUDY LIMITATIONS

- Patients dropping out of the study – Before enrollment patients were educated well and also captured their phone contacts for follow up.
- Inter observer variability on interpretation of Xrays for fracture classification-mitigated by discussing with the radiologist and consultant orthopaedic surgeon.

2.11 DISSEMINATION OF THE STUDY FINDINGS

Findings of the study will be disseminated in a three tier fashion. One copy of the published dissertation will be kept at the department of orthopedic, University of Nairobi. Another one will be placed at the university library. The highest level of sharing of the findings will be through publication in a peer reviewed journal.

CHAPTER 3:RESULTS

A total of 82 patients were enrolled in this study with male being 74% and female being 26%.The mean age was 35.23 with a range of 19-63 years.

Table 1-Socio demographic characteristics -Age and Sex

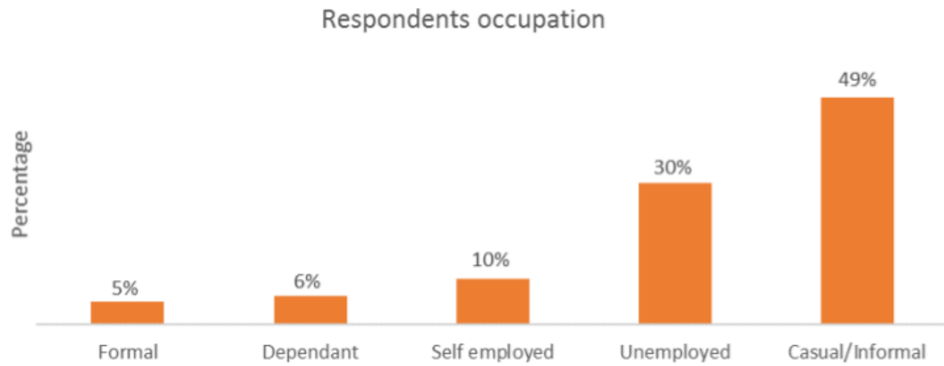
Patients between ages 21-30 were 34%,followed closely by 31-40 at 33% forming a total of 67% between ages 21-40.

Table 1

Patient Demographics

Demographics	Frequency	Percent
Sex		
Male	61	74%
Female	21	26%
Age, (Years)		
19 - 20	4	5%
21 to 30	28	34%
31 to 40	27	33%
41 to 50	15	18%
>50	8	10%
Age (Mean &Std. Dev)	35.23	10.4
Age (Min & Max)	19	63

Figure 2;Distribution of participants by type of occupation



The greatest proportion of participants that sustained distal tibia fractures were casuals or in the informal sector 49%,followed by unemployed 30% and least were seen in the formal sector 5%.The dependants and self employed were 6% and 10 % respectively.

Table 2-Side of injury, degree and mechanism of injury.

		Count	Percentage
Which limb was affected	Total	82	100%
	Right	53	65%
	Left	29	35%
Degree of injury	Total	82	100%
	Low energy	18	22%
	High energy	64	78%
Aetiology of injury	Total	82	100%
	Motor vehicle RTA	28	34%
	Gun shots	1	1%
	Fall	21	26%
	Sports	4	5%
	Assault	3	4%
	Motor cycle RTA	24	29%
	Bicycle RTA	1	1%

The mostly affected limb is the right leg 65% while the left sustained 35% of these fractures.Most of the injuries were high energy injuries 78%,with low energy 22%.The most common aetiological mechanism was motor vehicle RTAs 34%,followed by motorcycle RTAs 29%,while gunshots and bicycle were the least 1% respectively.

Table 3 Aetiological mechanism of injury

Motor vehicle RTA	**Total**	**28**	**100%**
	Driver	9	32%
	Passenger	7	25%
	Pedestrian	12	43%
Gun shots	Total	1	100%
	High velocity	0	0%
	Low velocity	0	0%
	Indeterminate	1	100%
Fall	Total	21	100%
	Simple	7	33%
	Down a gradient	4	19%
	Height	10	48%
Sport	Total	4	100%
	Contact	4	100%
	Non-contact	0	0%
Assault	Total	3	100%
	Blunt object	3	100%
	Sharp Object	0	0%
Motor cycle RTA	Total	24	100%
	Cyclist	3	13%
	Pillion	16	67%
	Pedestrian	5	21%
Bicycle RTA	Total	1	100%
	Cyclist	0	0%
	Pillion	1	100%
	Pedestrian	0	0%

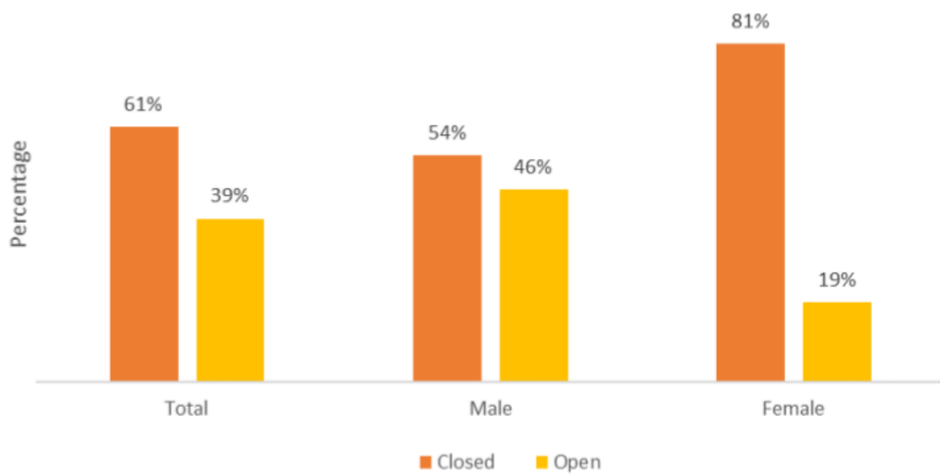
The motor vehicle RTAs had pedestrians as the mostly injured 43%,drivers 32% and passengers 25%.

Table 4:Type of fracture by mechanism of injury.

		Total	Open	Closed
Mechanism of injury	Motor vehicle RTA	34%	53%	22%
	Motor cycle RTA	29%	28%	30%
	Fall	26%	16%	32%
	Sports	5%	0%	8%
	Assault	4%	0%	6%
	Gun shots	1%	3%	0%
	Bicycle RTA	1%	0%	2%

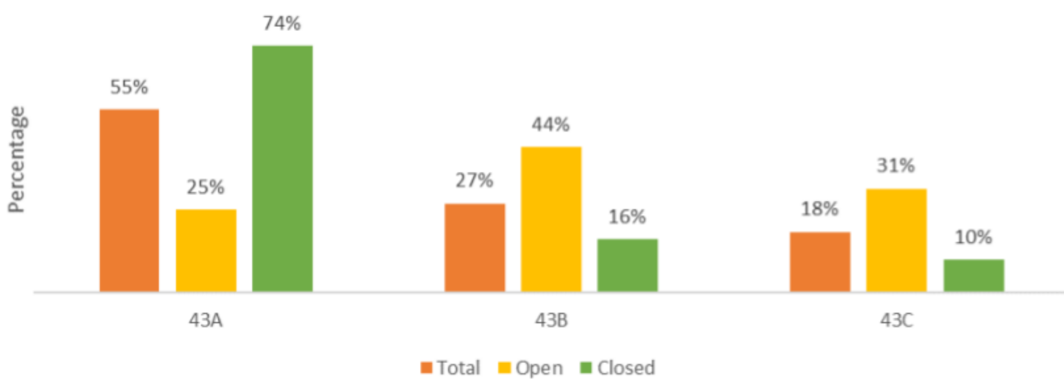
Motor vehicle RTAs accounted for most of the open fractures 53%,while falls accounted for most of the closed fractures 32%.Motorcycle accidents accounted for 30% of the closed fractures.

Figure 3:Fracture Morphology by gender



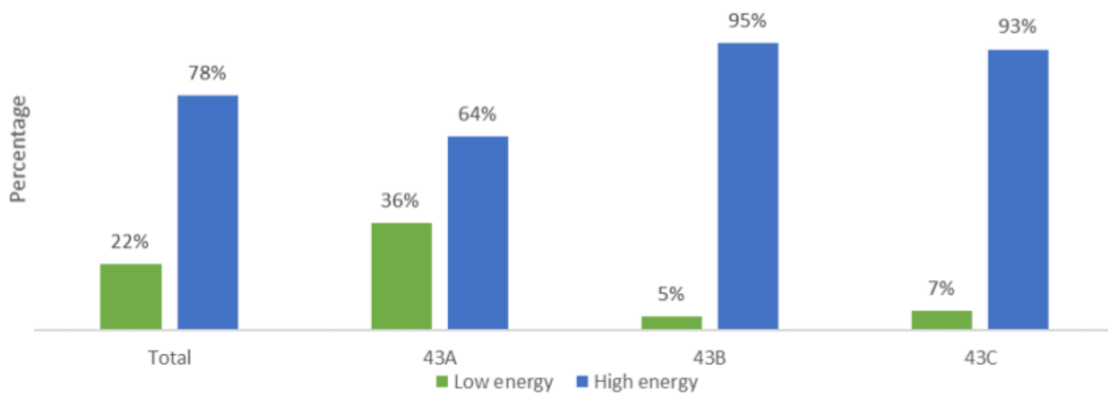
Closed fractures were more 61% while open fractures 39% with females having the most closed fractures 81%.

Figure 4:OTA fracture classification



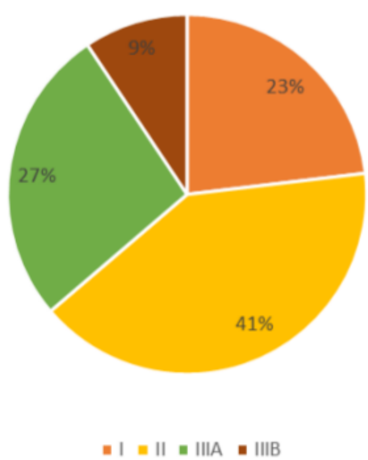
The most fracture morphology was 43A 55% with the least being 43C 18%.Closed fractures were the majority of the 43A group 74% and they were the least of 43C group at 10%.

Figure 5:Degree of injury and OTA classification



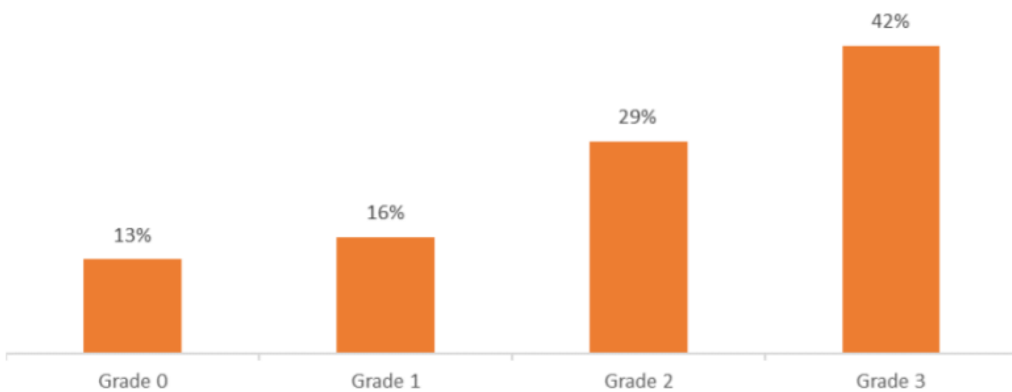
Most injuries were high energy 78% and 22% were low energy injuries.Most of the 43B fractures 95% resulted from high energy,as well as most 43C fractures at 93%.

Figure 6: Gustillo classification among open fracture types



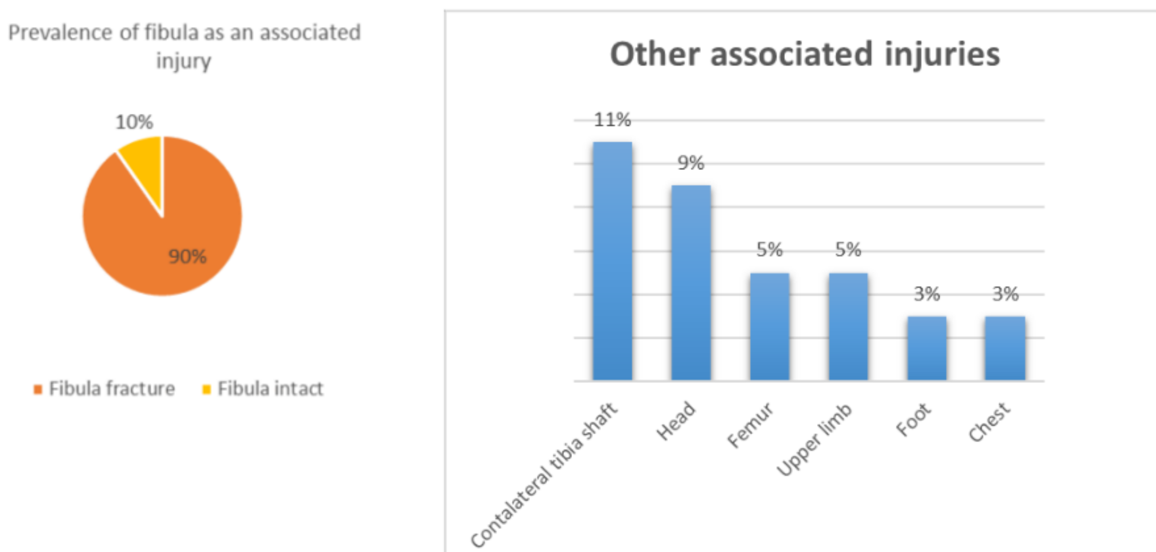
Gustillo type II accounted for most of the open fractures 41% with IIIB the least 9%.

Figure 7: Tscherne classification of closed fractures with soft tissue injury



The closed fractures had severe soft tissue injuries with 42% being in grade 3 while 13 % were grade 0.

Figure 8: Associated injuries



Fracture fibula was the most commonly associated injury 90% while only 10% had an intact fibula.Other associated injuries had contralateral tibial shaft 11% and least affected was chest andfoot at 3% respectively.

Table 5: Treatment methods

		Count	%
Temporary stabilization	Total	82	100%
	External fixator	18	22%
	Backslab	59	72%
	Calcaneal traction	5	6%
Definitive stabilization	Total	82	100%
	Plating	14	17%
	External fixator	22	27%
	Casting	46	56%

Most of the patients were managed non operatively with casting 56% while the least were operated on with plating 17%.

Table 6;Average time in days from temporary fixation to definitive treatment

	n	Min	Max	Mean	Std. Deviation
Backslab to casting	37	3	14	6.14	2.451
Backslab to Plating	11	5	13	8.73	2.796
External fixator to Plating	3	8	12	10.33	2.082
External fixator to POP	4	14	28	21.00	8.083
Calcaneal traction to P.O.P	5	14	21	16.00	2.915

The average duration of time to definitive management was highest for external fixator to casting with Plaster of Paris 21 days±8,followed by calcaneal traction

16±2.9

Fracture Morphology	p-value

		Total		Open		Closed		
		n	%	n	%	n	%	
		82	100%	32	39%	50	61%	
Compartment syndrome	Day 3 after injury	1	1%	1	3%	0	0%	
Superficial infection		4	5%	2	6%	2	4%	
Deep infection		3	4%	3	9%	0	0%	0.056
Wound dehiscence		1	1%	0	0%	1	2%	
Compartment syndrome	Week 2 post injury	0	0%	0	0%	0	0%	
Superficial infection		22	27%	16	50%	6	12%	<0.001
Deep infection		16	20%	15	47%	1	2%	<0.001
Wound dehiscence		9	11%	4	13%	5	10%	
Compartment syndrome	Week 6 post injury	0	0%	0	0%	0	0%	
Superficial infection		2	2%	1	3%	1	2%	
Deep infection		9	11%	8	25%	1	2%	0.390
Wound dehiscence		3	4%	0	0%	3	6%	

Table 7;Early complications by fracture type

The most common early complication was superficial infection seen at 2 weeks 27% and were associated with fractures that were open 50%.Deep infection was also common 20% at week 2.

CHAPTER 4:DISCUSSION

In this study distal tibia fractures occurred more in males than in females that is 74% for males and 26% for females (Table 1).Males are the ones who are involved in most of the economic activities to fend for their families hence their predominance in having these fractures.This compares with other studies by Holagundi et al who found 80.6% males and 19.3% females (16).Irfan et al found 87.5% to be males and 12.5% to be females (17).

Most patients in this study were in the age group 21-40years comprising of 67% with a mean age of 35.23 (Table1).In a Tunisian study the mean age of the population sustaining these fractures was 40years,with a range of 20-73 years though they had a sample of 30 patients (51).In a Tanzanian study the most common age group was 21-30 with 52.1% of distal tibial fractures (52).The 21-30 age group is less in this study than Tanzanian because of the small sample size.

In this study ,the common age group is the young and it is the one that is economically active and therefore engage in work or activity from which they are able to provide for their families hence sustaining these fractures.

As concerns economic activity or occupation of these patients,most are either in the informal sector or casual workers accounting for 49% (Figure 2).The least were in the formal sector with 5% .This can be explained by the fact that most patients being either in the motorcycle business of transporting passengers or most of the construction workers can only access medical care at the Kenyatta National Hospital.Most of the formally employed would have medical cover to access healthcare at the private facilities and also might not be involved in activities that place them at the risk of sustaining these fractures.

High energy fractures accounted for a majority of these fractures at 78% while low energy fractures accounted for 22% (Table 2). Studies elsewhere found these high energy fractures to comprise a majority of the fractures in a range of 75-93% (53,54).

Road traffic accidents accounted for the most with motor vehicle accidents accounting for 34% and motorcycle accidents accounting for 29% (Table 2).These contributed to the high energy injuries that were seen in this study as these accidents involved high transmission of energy during impact.In the Nigerian population, RTAs were found to be the leading cause of fractures at 57.7% (3).When combined both motor vehicle and motorcycle accidents accounted for 63% of RTAs which is slightly more than that in Nigeria and this can be attributed to improved road network in Nigeria than in Kenya.

Most participants who sustained distal tibial fractures were pedestrians who were knocked by motor vehicles at 43%,followed by drivers at 32% (Table 3).Pedestrians are usually involved as they are either crossing the road or the motor vehicle veers off the road and knocks them by the roadside especially in scenarios where there are no foot bridges or walking lanes by the road sides.

For motorcycles,the pillion sustained distal tibia fractures at 67% while pedestrians sustained 21% (Table3).A study in Uganda found motorcycle crashes to constitute 73% of the trauma patients (22).Most motorcycle riders are usually not properly trained on proper road usage and there is a laxity in their regulation.Motorcyles have a high rate of causing fractures as they are affordable and have increased in number with lack of proper lanes for them.They are usually preferred as they are cheap and quick means of transport.

Falls accounted for 26% (Table 2) in this study with most of them being fall from a height at 48% which contributed to the high energy fractures (Table 3).

More than half of the fractures in this study were closed at 61% and open fractures were 39% (Figure 3).This compares to other studies that found closed fractures to be between 60-70% while open fractures constituted 30-40% (24,28,47).

Having most of the mechanism of injury being high energy,most fractures were closed but the amount of soft tissue injuries was high as evidenced by the Tscherne classification of closed fractures.Most of the soft tissue injury was in Grade 3 at 42% (Figure 7).

In this study,of all the open fractures,the most common were Gustillo Anderson class II at 41% followed by class IIIA at 27% (Figure 6).The least type of open fracture seen in this study was Gustillo class IIIB and there was no fracture seen of class IIIC.This compares to a study done in Kenya,Ethiopia and Pakistan in which the most common Gustillo class II at 36% with the least being IIIC with 1% (28).

AO/OTA fracture classification had most of the fractures as extra articular 43 A (55%),43 B (27%),and the least were 43 C (18%),(Figure 4).The mechanism of injury accounts for the majority of the extra articular fractures 43A being higher.The motor vehicle and motorcycle RTAs result in bending mechanisms unlike falls from heights which results in intra-articular fractures as the talus drives into tibial plafond resulting in intraarticular fractures.Other studies show extraarticular fractures to be 20-60% and 20-40% being intraarticular (30,31).In these injuries there were high number of falls from heights hence the higher intraarticular fractures as compared to this study.

This study found a majority of the patients had an associated fibula fracture at 90% unlike the intact fibula 10% (Figure 8).

Studies show fibula fractures occur in 75-95% which compares to this study (32,33,44).Fibular fractures in this study show the degree of energy imparted on the limb, with intact fibula showing low energy while fractured fibula indicating high energy fracture.Fibula fixation in distal tibia fractures restores the length especially when using external fixator.Other associated injuries include contralateral tibia 11%,head injury 9%,femur 5%,upperlimb 5% and the least being chest 3%.

This differs from study by Holagundi who found 12% head injury,6.6% clavicle,6.6% medial malleoli fractures (16).This can be due to the improved road safety measures unlike in the local setup and also in his study he had a small sample size of 30 participants.

In this study patients who sustained associated injuries required inpatient care and this had an impact on the complications encountered.

Treatment of distal tibia fractures is quite challenging given the impact the soft tissue status has on management of these fractures.

In this study most patients were managed with backslab initially at 72%,external fixator at 22% and calcaneal traction at 6% (Table 5).This was done to give time for soft tissues to resolve before definitive management.The average time from injury to definitive management depended on status of soft tissues and type of definitive treatment.It took an average time of 6.14 days to convert a backslab to an above knee cast for the closed extra articular fractures (Table 6).For the ones operated on with plating it took an average 8.73 days.From external fixator to definitive treatment it took an average of 21 days to convert to casting and 10.33 days to convert to plating.For calcaneal traction it took average of 16 days to casting in this study (Table 6).

Stephens et al had an average time of 4.1 days±5(range 0-27) from time of injury to fixation (28).Sirkin et al had an average of 12.7 days from external fixation to open reduction for closed fractures and 14 days (range 4-31 days) from external fixator to open reduction for open fractures (43).Studies have shown that managing these fractures in a staged manner drastically reduces the incidences of complications i.e wound infections emanating from the severely damaged soft tissue cover.In this study,most patients were converted to casting with plaster of paris as the costs of internal fixation could be prohibitive for most patients.

Most patients were definitively managed with casting at 56%,external fixator at 27% and open reduction and internal fixation at 17% (Table 5).Patients who sustained open fractures in this study underwent debridement,antibiotic cover and external fixation.Most of these ended up being the definitive mode of treatment.

In this study early complications were looked for at day 3,week 2 and week 6.There was one case of compartment syndrome 1%.Fasciotomy was done and fracture stabilized with an external fixator and by 6 weeks the wounds had healed with skin grafted at the wound.This compares well with a study done by Kostler in which he found a range of 1-29% incidence of compartment syndrome in closed fractures (45).

Superficial infections were common in this study at 27% at week 2 and were predominant in the open fracture group 50%.In this study superficial infections occurred in day 3 upto week 2 and patients were put on oral antibiotics, cleaning and dressing and didn't require debridement.Studies show superficial infections to be between 6-20% (28,29,46).Open fractures and soft tissue damage were considered risk factors for these infections in these studies which were significantly higher in this study.

Deep infections in this study accounted for 20% in week 2 (Table 7).These infections correlated with increased fracture severity especially those with severe soft tissue damage and open fractures of high gustillo grade.These infections required several debridements and a course of intravenous antibiotics.Sirkin et al found 3.6% deep infection with staged treatment of these fractures (43).Most patients were managed definitively with an external fixator in this study while Sirkin converted external fixators to internal fixation.This could explain the difference in the infection rate.Blauth et al showed reduced infection rate especially with 2 stage protocol at 12.5% unlike in one stage internal fixation at 33% (47).

Wound dehiscence in this study followed operative treatment of distal tibia fractures with plating and external fixation 11%.A majority of the internal fixation was open reduction which causes more soft tissue damage.In comparison , other studies show an incidence of wound dehiscence to be 1-8% following open reduction internal fixation (43,46).The difference in comparison is as result of most of those studies had minimally invasive osteosynthesis unlike the open reduction in this study.

4.1 CONCLUSION

1) Patients who sustained these fractures were relatively young with males being affected more
2) The most common cause of distal tibia fractures are motor vehicle accidents followed closely by motorcycle accidents.
3) Closed fractures are the majority with extra articular fractures 43 A being the most common as well.
4) The most associated injury is fibula fracture.
5) Most patients with distal tibia fractures were definitively managed with casting

6) The most common early complication of these fractures is superficial infection that occurred at week 2.

4.2 RECOMMENDATIONS

Modalities and policies need to be enforced on road safety measures to reduce on motor vehicle and motorcycle accidents.

There is need for a longer,multicentered and larger study on distal tibia fractures to come up with adequate recommendations.

Pattern Of Distal Tibial Fractures, Associated Injuries And Early Complications At Kenyatta National Hospital.

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